Growth of early weaned lambs on a plantain-clover mix compared with lambs suckling their dam on a plantain-clover mix or a grass based sward

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Keywords: early weaning; lambs; herb; plantain; clover

Abstract

Plantain-clover mixes have high metabolisable energy content and have been shown to support greater liveweight gains in lambs both pre- and post-weaning when compared with grass. The aim of this experiment was to determine if a plantain-clover mix could be used as a means to wean lambs earlier. Twin-bearing ewes (n=67) with both lambs at a minimum live weight of 16 kg each were allocated to one of three treatments; 1) ewe and lambs together on grass, 2) ewes and lambs together on plantain-clover mix, 3) lambs weaned at approximately 8 weeks of age onto a plantain-clover mix and ewes on grass. Lambs that were weaned early were lighter ($P<0.05$) at approximately 14 weeks of age than those which remained with their dam on either a plantain-clover mix or grass (32.3±0.43 vs 34.7±0.44 vs 33.7±0.45 kg, respectively). However, ewes which had their lambs weaned early were heavier ($P<0.05$; 79.7±1.73 vs 75.5±1.68 vs 75.9±1.64 kg, respectively) and in better body condition score ($P<0.05$; 3.1±0.05 vs 2.9±0.05 vs 2.9±0.05, respectively) than those which remained with their lambs on either a plantain-clover mix or grass. This suggests early weaning improved ewe condition but did not improve lamb performance

Introduction

In New Zealand, sheep-production systems are largely based on perennial ryegrass (*Lolium perenne*) and white clover (*Trifolium repens*) swards (Kemp et al. 2002). Lambs are born in late winter/spring to match peak pasture growth rates (Valentine & Kemp 2007) and are normally weaned between 10 and 14 weeks of age (Geenty 2010). The growth rate of suckling lambs is dependent on milk and herbage intake, and the efficiency of utilisation of the absorbed nutrients. Ewe milk production peaks between weeks 1-2 of lactation and is very limited post week 9 of lactation (Paten et al. 2014; Peterson et al 2006). Early weaning of lambs between 6-9 weeks of age has the potential to increase the efficiency of pasture utilisation by allocating forage of greater quality and allowance to lambs, and poorer quality and restricted allowances to the ewes in late spring/early summer. Alternatively, if growth rates can be, at least, maintained by early weaning on suitable herbages, it allows for cast-for-age ewes to be sold earlier, thereby saving herbage.

Weaned lambs (aged four months) grazing plantain and clover mixes containing plantain (*Plantago lanceolata*), red clover (*Trifolium pratense*) and white clover showed greater liveweight gain than those grazing perennial ryegrass and white clover swards (Somasiri et al. 2015). This has also been observed in suckling lambs (0-10 weeks of age) grazing a sward mix containing chicory (*Cichorium intybus*), plantain, red clover, and white clover (Corner-Thomas et al. 2014; Hutton et al. 2011). These plantain and clover mixes may be ideal for the early weaning of lambs. Therefore, the aims of the present experiment were to investigate the effects on lamb growth and ewe live weight and condition of weaning lambs early (at ~ 8 weeks of age) onto a plantain-clover mix compared with keeping lambs with their dams on either a plantain-clover mix or a grass based sward.

Materials and methods

Experimental design

The experiment was conducted at Massey University's Tuapaka Hill Country Farm, 15 km east of Palmerston North, New Zealand (40°21'S, 175°45'E). Sixty seven twin-bearing ewes (identified using trans-abdominal ultrasound) and their 134 lambs were used in this experiment. Throughout gestation the ewes were managed together under commercial conditions. All ewes gave birth during the period 4 to 22 September 2015. At birth, lambs were weighed, tagged and matched to their dam. On 10 November 2015 (59 days after the midpoint of lambing; L59) all lambs weighed a minimum of 16 kg and ewes and their lambs were allocated to one of three treatment groups until L96;

1. Lambs suckled their dams fed on a grass-based sward (suckled grass)
2. Lambs suckled their dams fed on a plantain-clover mix (suckled plantain-clover)
3. Lambs were weaned and fed on a plantain-clover mix and dams fed on a grass based sward (early-weaned plantain-clover)

Throughout the experiment stocking rates were adjusted to ensure that ewes and lambs had *ad libitum* intakes. Therefore, those grazing the plantain-clover mix were shifted into a new grazing area when the sward height reached a minimum of 7 cm and those grazing the grass based sward were shifted when herbage mass reached a minimum of 1500 kg DM/ha.

The grass based sward was a long established hill-country pasture which contained browntop (*Agrostis capillaris*), perennial ryegrass, Yorkshire fog (*Holcus lanatus*), other grasses and white clover. The plantain-clover mix was sown in the autumn of 2015 and contained plantain, red clover and white clover. Lambs and their dams in the suckled plantain-clover treatment and the early-weaned plantain-clover treatment were grazed on the plantain-clover mix for increasing increments between L59 and L62 (2, 4, 6, 8 hours daily, respectively) so that the lambs adjusted to the plantain-clover mix (Mathews & Kilgour 1979; Thorhallsdottir et al. 1990). At L65, dams were removed from the early-weaned plantain-clover treatment and lambs were weaned.

Animal and herbage measurements

Ewe and lamb live weights were recorded within one hour of removal from pasture at L59, L68, L82 and L96. Ewe body condition score (BCS) scale 1.0-5.0 including half units; (Jefferies 1961; Kenyon et al. 2014) was also recorded at L59, L68, L82 and L96 by a single experienced operator.

Herbage mass and botanical composition were measured on L59, L74, L82 and L96. Herbage mass was measured by taking four 0.1 m^2 quadrat cuts (Frame 1993) at ground level. The samples were then washed before drying in a draught oven for at least 24 h at 70°C (four samples per forage treatment). Botanical composition samples were collected by cutting four 0.5 m × 0.1 m wide strips per forage treatment. A subsample of these (~30 g) was then separated into species and dried in a draught oven at 70°C for at least 24 h before botanical composition was established.

Grab herbage samples (Frame 1993) of the grass and plantain-clover mix treatments (~100 g wet weight) were collected from each paddock on L59 (four samples per forage treatment). All samples were freeze-dried and ground to pass a 1-mm sieve and analysed for *in vitro* digestibility (with metabolisable energy (ME) calculated as digestible organic matter digestibility × 0.163) according to the method of Roughan & Holland (1977) and crude protein (CP; total combustion method (Robertson & Van Soest 1981)).

Statistical Analysis

All statistical analyses were performed using the MIXED procedure in SAS (Statistical Analysis System, version 9.2; SAS Institute Inc., Cary, NC, US). Lamb live weight was analysed allowing for repeated measures in a model including the fixed effects of sex of the lamb, measurement time, forage treatment and the interaction between measurement time and forage treatment. Ewe was fitted as a random effect and date of birth as a covariate. Lamb liveweight gain was analysed in a model including the fixed effect of forage treatment and including sex of the lamb and date of birth as covariates.

Ewe live weight and body condition score were analysed allowing for repeated measures in a model including the fixed effects of measurement time, forage treatment and the interaction between measurement time and forage treatment. The model included date of lambing as a covariate.

Herbage masses, ME and CP were analysed in a model including the fixed effect of forage treatment. Botanical composition was analysed in a model including the fixed effect of species. All significances are judged and expressed in the results section at $P<0.05$.

Results

Herbage mass, composition and quality

Throughout the experimental period (L59-L96), the average dry matter on offer did not differ between the grass based sward and plantain-clover mix treatments; 3647 ±

Table 1 Effect of treatment; lambs suckled dams on a grass based sward (suckled grass), lambs suckled dams on a plantain-clover mix (suckled plantain-clover), lambs were early weaned onto a plantain clover mix (early-weaned plantain-clover) on the live weight (mean ± SEM) of twin-reared lambs at L59, L68, L82, L96 and their liveweight gain (mean ± SEM) between L59 and L96. Means within columns with different letters are significantly different ($P<0.05$).

		Lamb live weight (kg)				Lamb liveweight gain (g/day)
Treatment	*n*	At L59	At L68	At L82	At L96	Between L59 and L96
suckled grass	44	22.1 ± 0.45	25.0 ± 0.45	29.5b ± 0.45	33.7b ± 0.45	318b ± 8
suckled plantain-clover	44	22.7 ± 0.44	25.3 ± 0.44	29.9b ± 0.44	34.7b ± 0.44	327b ± 8
early-weaned plantain-clover	46	23.0 ± 0.43	25.1 ± 0.43	28.3a ± 0.43	32.3a ± 0.43	255a ± 8

Table 2 Effect of treatment; lambs suckled dams on a grass based sward (suckled grass), lambs suckled dams on a plantain-clover mix (suckled plantain-clover), lambs were early weaned onto a plantain clover mix (early-weaned plantain-clover) on the live weight (mean ± SEM) and body condition score (BCS; mean ± SEM) of twin-bearing ewes at L59 and L96. Means within columns with different letters are significantly different ($P<0.05$).

		Ewe live weight		Ewe BCS	
Treatment	*n*	At L59	At L96	At L59	At L96
suckled grass	22	70.6 ± 1.64	75.9a ± 1.64	2.7 ± 0.05	2.9a ± 0.05
suckled plantain-clover	22	70.7 ± 1.68	75.5a ± 1.68	2.7 ± 0.05	2.9a ± 0.05
early-weaned plantain-clover	23	72.0 ± 1.73	79.7b ± 1.73	2.7 ± 0.05	3.1b ± 0.05

231 vs 3751 ± 207 kg DM/ha, respectively. The grass based sward had an average composition of 23 ± 1.9% browntop, 22 ± 1.9% perennial ryegrass, 16 ± 1.9% Yorkshire fog, 30 ± 1.9% other grasses, 6 ± 1.9% white clover and 3 ± 1.9% other species. The plantain-clover mix had an average composition of 64 ± 1.7% plantain, 9 ± 1.7% red clover, 6 ± 1.7% white clover and 21 ± 1.7% other species.

At L59, the grass based sward had a lower ($P<0.05$) metabolisable energy content than the plantain-clover mix; 10.4 ± 0.04 vs 10.7 ± 0.04 MJ ME/kgDM, respectively. However, the grass based sward had a higher ($P<0.05$) crude protein content than the plantain-clover mix; 22.6 ± 1.43 vs 15.9 ± 1.43%, respectively

Lamb live weight and liveweight gain

The live weight of lambs did not differ between the treatment groups at L59 or L68 (Table 1). At L82 and L96 the lambs in the early-weaned plantain-clover treatment were lighter ($P<0.05$) than those in both the suckled grass treatment and the suckled plantain-clover treatment, which did not differ from one another. The early-weaned plantain-clover treatment group of lambs had a lower ($P<0.05$) rate of liveweight gain between L59-L96 than those in both the suckled grass treatment and the suckled plantain-clover treatment, which did not differ from one another.

Ewe live weight and body condition score

There was no difference in the live weight or BCS of ewes between the three treatment groups at L59 (Table 2). At L96 the ewes in the early-weaned plantain-clover treatment were heavier ($P<0.05$) and had a higher ($P<0.05$) BCS than those in both the suckled grass treatment and the suckled plantain-clover treatment, which did not differ from one another.

Discussion

Lambs which remained with their dams on either the grass based sward or a plantain-clover mix were 1.5-2.5 kg heavier at ~14 weeks of age than those lambs which were weaned at an average of 22 kg and a minimum of 16 kg (eight weeks of age) onto a plantain-clover mix. Other research has shown that weaning lambs at 8-9 weeks of age had no negative effect on their live weight at conventional time of weaning compared with weaning between 12-15 weeks of age (Geenty 1980; Smeaton et al. 1983). In the current experiment, it was expected that the plantain-clover mix would have adequate crude protein content and a greater metabolisable energy content than the grass based sward, and therefore, could help compensate for the milk content of the diet. However, the crude protein content of the plantain-clover mix was at the lower end of that required for lamb growth (15-18%) (Hodgson & Brookes 2002) and combined with the relatively small improvement in metabolisable energy content (0.3 MJ ME/kgDM) compared with the grass based sward it was not sufficient to compensate for milk. It should also be noted that herbage intakes were not restricted and the metabolisable energy and crude protein content in the grass based sward would be considered adequate for lamb growth (Hodgson & Brookes 2002). Therefore, this study suggests that, under adequate pasture conditions, there is no advantage for lambs in an early weaning system. Further studies may wish to consider the impact of early weaning under conditions where pasture levels are below optimum (a common scenario during lactation).

The live weight of lambs at ~14 weeks of age and the live weight and body condition of their dams did not differ between those grazing a grass based sward or a plantain-clover mix. Again it is possible that this is due to the unrestricted feeding conditions in both forage treatments and the small difference in metabolisable energy content. It has been previously shown that grazing ewes on a herb and clover mix can increase milk production (Hutton et al. 2011) which might help explain the improved lamb liveweight gain observed by Corner-Thomas et al. (2014) and Hutton et al. (2011), whereby, ewes were set-stocked prior to lambing on either a herb and clover mix or ryegrass/white clover. Conversely, in a similar study, Kenyon et al. (2010) found no difference in the live weight of lambs at weaning; matching that found in the present study.

Ewes whose lambs were weaned early (at an average of 22 kg) were 4 kg heavier and had a greater BCS (0.2 units) at the time of conventional weaning. Previous research has also shown weaning lambs early (between 6-8 weeks of age) has a positive effect on ewe live weight at both the time of conventional weaning and at joining and on their subsequent breeding performance (Corbett & Furnival 1976; Smeaton et al. 1983). Furthermore, early weaning could allow for cull ewes to be sold earlier, thereby reducing overall feed demand as well as receiving higher slaughter prices (Beef + Lamb New Zealand 2015). It would also allow lambs to be stocked at a higher rate per hectare on a plantain-clover mix.

Conclusion

This experiment indicates that lambs weaned at an average of 22 kg and a minimum of 16 kg onto a plantain-clover mix, display a check in live weight at 14 weeks of age compared with those lambs which continue to suckle their dam on either a grass based sward or a plantain-clover mix. Under conditions in which there was *ad libitum* herbage and only a small difference in the quality of the grass based sward compared with the plantain-clover mix, there was no difference in the performance of ewes and their suckling lambs on the two forage treatments. In contrast, ewes which had their lambs weaned early were able to gain more liveweight and body condition than ewes which remained with their lambs.

Acknowledgements

The authors acknowledge technical assistance given by Mr Dean Burnham. In addition, the authors thank Beef and Lamb New Zealand for funding this experiment.

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